PRESUMPTIVE MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY

RUBBER TIRE MANUFACTURING SOURCE CATEGORY

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1.0 INTRODUCTION

This document presents preliminary information gathered by the United States Environmental Protection Agency (EPA) on sources of hazardous air pollutant (HAP) emissions in the rubber tire manufacturing industry, control techniques that the industry uses to reduce HAP, and the potential impacts of controls. This document should not be considered as establishing definitive requirements that must be followed in all cases. This document is referred to as a "presumptive MACT" (P-MACT) and represents the Agency's findings based on available information to date.

1.1 Clean Air Act Requirements

The Clean Air Act as amended in 1990 (Act), under section 112(b), lists 188 HAP and requires the EPA to regulate categories of major and area sources that emit one or more of these pollutants. Standards to limit emissions of HAP are to be technology-based and are to require the maximum degree of emission reduction determined to be achievable by the EPA Administrator. Such emission reduction methods are called maximum achievable control technology (MACT). As prescribed in section 112(d) of the Act, the level of control for existing sources shall be no less stringent than:

> ...the average emission limitation achieved by the best performing 12 percent of the existing sources...for categories and subcategories with 30 or more sources, or...the average emission limitation achieved by the best performing five sources...for categories or subcategories with fewer than 30 sources.

This minimum level of control is referred to as the "MACT floor." The MACT floor level for new sources:

> ...shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source.

The MACT floor for a source category is based on available information. The level of control corresponding to the MACT floor must be determined as a starting point for developing regulatory alternatives. Once the MACT floor has been determined, the EPA must set MACT standards that are no less stringent than this floor. These standards must be met by all major sources within the source category or subcategory.

If the EPA fails to set MACT standards within the required timeframe, section 112(j) of the Act requires the States to establish emission limitations using a case-by-case determination of what the federal standard would have been. Case-by-case MACT determinations under section 112(j) will require substantial information and resources from State and local agencies, industry, and environmental groups, and there appears to be a strong incentive for all parties involved to gather information for section 112(j) determinations and to promulgate standards within the required timeframe. The amount of work needed to complete all of the 7-year and 10-year standards on time is difficult to predict. The EPA believes that new approaches are needed to reduce the amount of work and time associated with standards development. To achieve this goal, the EPA has initiated a new standard development process called MACT Partnerships, that may involve a partnership between States, industry, and environmental organizations. This process is described in the March 29, 1995 Federal Register (60 FR 16089).

The MACT Partnerships program involves two phases. The first phase, which is independent of the second phase, involves the development of a P-MACT. A P-MACT is not a standard; it serves as a statement of current knowledge of MACT and a basis for a decision on how to develop the emission standard for the source category involved. The second phase is the formal standard development process. For the second phase, the EPA envisions the use of one of three basic regulatory development paths: adopt-a-MACT, share-a-MACT, or a streamlined-traditional approach. In all cases, the EPA would eventually propose and then promulgate the MACT standard.

The adopt-a-MACT and share-a-MACT paths have involved formal and informal agreements with States and industry to take primary or shared responsibility for developing the underlying data and analyses that the EPA would accept and process as MACT. When no suitable partners can be found, or a standard appears suitable for development by the traditional process, the EPA would go through a “streamlined-traditional” process of rule development.

There has been considerable development of information on behalf of the industry for rule development consideration. In addition, recent interest by a State has prompted the EPA to consider the Share-a-MACT process for further MACT development. The partnership is expected to provide the EPA with industry information to assess the MACT, and State and local agency coordination and timely input to the process. The EPA will continue to lead the deliberation on the MACT activities with these partners and process the necessary rule.

1.2 Project Background

On July 16, 1992, the initial list of categories of sources that will be regulated under section 112 was published in the Federal Register (57 FR 31576). “Rubber Tire Manufacturing” was included in the list as a category of major sources.

The rubber tire manufacturing industry was the subject of a New Source Performance Standard (NSPS) published in 40 CFR Part 60 Subpart BBB, and promulgated on September 15, 1987 (52 FR 34874). The NSPS was used as a starting point in developing some of the provisions in this P-MACT.[1] Since that time the rubber tire manufacturing industry has changed dramatically in many ways, including the operation of fewer facilities producing more tires, a reduction in the number of tire components that are cemented, reduction in the amount of cement used in those components, reduction of HAP content in the cements used, and the trend in light duty truck and passenger tire production from bias belted tires to radial tires. As a result of the MACT partnership with industry and State regulatory agencies, the EPA collected process and emissions information on the rubber tire manufacturing source category. This information, also used for the development of P-MACT, was obtained from representatives from the Rubber Manufacturers Association (RMA), and the States of Mississippi, North Carolina, South Carolina, California, Virginia, and Texas.

On April 2, 1998, a meeting was held with the EPA and the RMA to obtain feedback on the draft P-MACT. Some of the comments made during that meeting have been incorporated into this document, while others will require additional research before they can be resolved. The purpose of this document is to present the EPA's current knowledge for the rubber tire manufacturing source category and to describe issues that need further clarification and possible resolution during the MACT and NESHAP development.

The EPA wishes to emphasize that this P-MACT is a regulatory status document and does not represent a final EPA decision on the emissions limitations that may finally apply in the MACT standard when issued. The EPA has not completed all of the requirements necessary to issue a standard for this source category. This P-MACT is intended as an information tool to guide MACT development, or to assist State permitting authorities or EPA Regional Offices, as necessary, as they initiate development of case-by-case MACT determinations under either section 112(g) or section 112(j) of the Act. It should not be treated as establishing definitive requirements that must be followed in all cases.

In addition, the preliminary data used as the basis for this P-MACT is heavily weighted toward passenger and light duty truck tire manufacturing facilities due in part to the availability of information for this aspect of rubber tire manufacturing. Although this information appears applicable to the emissions of HAP from the rubber compound used in all types of tire manufacture, continued evaluation of other process operations for non-passenger tires and further evaluation of unique rubber compounds that deviate from the proposed industry wide RMA emission factors (EF) maybe necessary before this can be positively concluded. The current emisiion factors in proposed EPA AP-42 address emission factors and HAP emissions for the majority of rubber compounds used in the industry for all tires and are based on a pounds of HAP per pound of rubber processed through various manufacturing steps. These emission factors do not include HAPs associated with cements, solvent or adhesives used per facility. Therefore, the information presented in this document may not accurately address individual facility quantities of HAP emissions from cement or solvents. Further information or an alternative regulatory approach may be needed to address HAP emissions from cementing and solvent use associated with different types of rubber tire manufacture.

2.0 INDUSTRY AND SOURCE CATEGORY DESCRIPTION

The rubber tire manufacturing source category includes any rubber tire manufacturing facility, or any facility that manufactures rubber tire components as a primary product (e.g., a facility that mixes rubber compound for use in making rubber tires at another manufacturing facility or tire cord production facilities) directly associated with rubber tire production that is a major source, or is located at a major source facility site. The affected sources and processes within the tire manufacturng industry are furhter identified below. The most inclusive Standard Industrial Classification code (SIC) associated with this MACT development is 3011. A major source is any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in the aggregate, 10 tons per year of any HAP or 25 tons per year of any combination of HAP.

2.1 Applicability/Primary Product Determination

The primary product of the affected source is rubber tires of any size or shape, solid or pneumatic, consisting of natural or synthetic rubber, or combination thereof. Some examples of tires, the production of which are covered under this source category, include:

- passenger car
- light, medium, and heavy duty truck
- cycle/motorcycle
- go kart
- racing
- industrial rolling stock
- bus
- farm
- off-the-road and all-terrain vehicle
- aircraft
- grader/earthmover/loader
- mining/logging
- high performance
- agricultural and forestry

This definition is more inclusive than the scope of the NSPS, and includes a wider variety of smaller and larger tires than does the NSPS. Although the current industry evaluation has not identified affected sources, in addition to rubber tire manufacturing facilities, facilities that manufacture components used in rubber tire manufacturing (e.g., facilities that manufacture rubber tire components, as well as remolding (retreading) operations) may be subject to MACT based on the primary product applicability definition.

2.2 Information Sources

Information was gathered from the RMA, State files, existing literature, site visits to rubber tire and tire cord manufacturing facilities, and HAP emissions inventories from rubber tire manufacturing facilities. That information has been used to characterize the industry as it exists today and to make a preliminary estimate of what the MACT floor is likely to be when all available information is collected. The information gathered to date is presented below.

2.3 Industry Characterization

Based on information currently available to the EPA from literature review, State files, and site visits, in the United States there are 14 manufacturers with 43 locations producing rubber tires.[2] Table 1 lists these manufacturers and the locations of their facilities. Note that "retreading" operations and tire cord manufacturers have not been included in Table 1.

Information available to the EPA indicates labor costs currently represent about 30 percent of the cost of tire and tube production for U.S. manufacturers. To keep these labor costs as low as possible, tire manufacturing facilities are located primarily in southern States where labor rates are lower than the national average. States that account for a large percentage of facilities include Alabama, Illinois, and Tennessee.

The two largest producers of original equipment (OEM) tires, Goodyear and Michelin/Uniroyal-Goodrich, accounted for approximately 66 percent in 1996. The four largest producers, Goodyear, Michelin/Uniroyal-Goodrich, Bridgestone/Firestone, and Continental/General Tires accounted for 97 percent of production, as shown in Table 2.[3]

TABLE 1. RUBBER TIRE MANUFACTURING FACILITIES

Owner	Location	State
Bridgestone/Firestone	Decatur	IL
	LaVergne	TN
	Warren County	TN
	Wilson	NC
	Oklahoma City	OK
	Des Moines	IA
	Bloomington	IL
Carlisle	Carlisle	PA
Continental/General Tires	Bryan	OH
	Charlotte	NC
	Mount Vernon[a]	IL
	Mayfield	KY
Cooper	Albany	GA
	Findlay	OH
	Texarkana	AR
	Tupelo	MS
Denman	Leavittsburg	OH

Dunlop Tires	Buffalo	NY
	Huntsville	AL
Fidelity	Natchez	MS
Goodyear	Akron	OH
	Freeport	IL
	Topeka	KS
	Danville	VA
	Gadsen	AL
	Tyler	TX
	Fayetteville	NC
	Lawton	OK
	Union City	TN

TABLE 1. RUBBER TIRE MANUFACTURING FACILITIES (CONT.)

Michelin	Greenville	SC
	Anderson	SC
	Spartanburg	SC
	Dothan	AL
	Lexington	SC
	Norwood	NC
Pirelli	Hanford	CA
Specialty	Indiana	PA
Titan	Des Moines	IA
Uniroyal Goodrich	Ardmore	OK
	Fort Wayne	IN
	Opelika	AL
	Tuscaloosa	AL
Yokohama	Salem	VA

a - This plant is a joint venture between Continental/General Tires, Toyo, and Yokohama. The plant is managed by Continental/General Tires.

TABLE 2. NORTH AMERICAN ORIGINAL EQUIPMENT PASSENGER/LIGHT DUTY TRUCK TIRE MARKET PERCENTAGE FOR 1996

Manufacturer	Market Percentage
Goodyear	36
Michelin/Uniroyal-Goodrich	30
Bridgestone/Firestone	18
Continental/General Tires	13
Other	3

Source: Tire Business Internet Site, April 1998, http://www.tirebusiness.com

3.0 PROCESS DESCRIPTION

3.1 General Process Description

The basic process of manufacturing a tire includes the following 11 steps:

(1) mixing of synthetic and natural rubber elastomers, process oils, carbon blacks, pigments, and other chemicals such as vulcanizing agents, accelerators, plasticizers, and initiators in an internal mixer (often referred to as a "Banbury" mixer). This process combines the raw material into rubber compound that will be used to manufacture tires;
(2) milling operations are performed to warm up rubber compound prior to extruding or calendering or to homogenize recycled rubber compound for reintroduction into the process;
(3) extruding operations are used to form rubber compounds into specific tire components, such as tread stock. During the extruding process rubber is forced through an extrusion die in a continuous stream. Extruders may be "hot feed" (warm-up mills used to feed rubber compound to the extruder) or "cold-feed" (rubber compound fed directly to the extruder);
(4) processing fabric and wire and coating them with rubber in a calendering operation. Rubber compound may be fed to a calender via mills or extruders;
(5) processing bead wires and coating them with rubber in an extruding and/or dip coating process;
(6) cementing and marking of beads, calendered materials, and extruded components;
(7) cutting and cooling the various extruded and calendered outputs;
(8) assembling all of the components (bead wires, coated fabrics, treads, etc.) on a tire-building machine;
(9) lubricating the green tire (green tire spraying);
(10) curing (vulcanizing, molding) the tire with heat and pressure; and
(11) finishing (e.g., grinding, buffing, painting) the product.

A detailed description of each of the above processes is provided in the following paragraphs. Figure 1 provides a simple facility schematic of the rubber tire manufacturing process. It is important to note that facilities may vary in the inclusion and refinement of these steps.

3.1.1 Mixing

Production of the rubber compound used to manufacture the various components used in tire production begins with the process called "mixing" or "compounding". Mixing involves weighing and loading the appropriate ingredients (natural and synthetic rubbers, oil, carbon black, zinc oxide, sulfur, and other company- and tire- specific enhancement chemicals) into an internal mixer. Once the ingredients are transferred into the mixer they are mixed for two or three minutes. The mixer creates a homogeneous mass of rubber using rotors that shear the materials against the walls of the machine's body. This

Source: The Rubber Manufacturers Association

Figure 1. Typical Facility Schematic for Rubber Tire Manufacturing

mechanical action also causes the temperature of the mixed compound to increase considerably. The mixed rubber compound is discharged to a drop mill, extruder, or pelletizer from the mixer and is processed into slab rubber or pellets. Rubber mixing typically occurs in two or more stages wherein the rubber is returned to the mixer and re-mixed with additional chemicals (typically two "passes" are used for most final compounds). It should also be noted that various rubber compounds produced at a particular facility may be exported to other facilities for use there.

3.1.2 Milling

Milling operations, the mechanical process of kneading and rolling rubber compound into a malleable warmed sheet, are conducted to prepare the rubber compounds prior to a process step, e.g., raising the compound temperature or viscosity for extruding. Milling operations ease handling and processing of the rubber compound and homogenizes recycled rubber compounds for reuse in the process. Milling operations occur at various steps in the tire process.

Typically the mill forms the rubber compound into a long sheet of rubber. Additional mills may be located directly downstream from the mixer drop mill to provide additional mixing or handling capability. Pelletizing is a step between mixing and milling used at some facilities to introduce additional uniformity of the compound in subsequent mixing. From the mill(s) or pelletizers the hot, tacky rubber sheet or pellets are passed through a water-based "anti-tack" solution typically a very low solid clay and water mixture (e.g., soapstone) that coats the slab or pellet to prevent the rubber sheets or pellets from sticking together as they cool to ambient temperature. The rubber sheets are placed directly onto a long conveyor belt that, through the application of cool air or cool water, lowers the temperature. After coating and cooling the rubber sheets are stored on a pallet or in a bin for transfer to the component preparation areas (extruding and calendering) or returned to the mixer for further compounding.

Mills are also used to prepare rubber for introduction to calendering and extruding processes. In these production areas the mills are used to prepare the compound , e.g., heating and viscosity, in order to make the rubber stock more fluid for further handling and processing.

3.1.3 Extruding

The extruder transforms the milled rubber into various shapes (i.e., tread stock, sidewall stock) or profiles by forcing it through dies via a rotating screw. Extruders may have multiple heads providing lamination of extruded shapes. Extruding, whether cold or hot extruding, heats the rubber and the rubber remains hot until it is cooled via air cooling or use of a water bath or spray conveyor where cooling takes place. Extruders may be utilized in the mixing area, along with mills to shape mixed rubber compound for further processing.

3.1.4 Calendering

Calenders receive hot strips of rubber from mills and squeeze the rubber into reinforcing fibers of cloth or steel or cloth-like fiber matrices, thus forming thin sheets of rubber coated materials. The calender applies a rubber compound film to a web surface, typically a fabric tire cord or steel belt, using a combination of milling operations and thickness-controlling rollers. The calendered product may then be partially curred using an irradiation unit.

Calenders also produce non-reinforced, thickness-controlled sheets of rubber called innerliner or gum strip. This activity is necessary for production of other components of the tire that are supplied to the tire building area.

The calendered stock is wound into a cloth liner to prevent sticking on itself. The calendered stock is subsequently cut to desired width, length, and angle to provide the components for tire reinforcement needs. These components are then supplied to the tire building area.

3.1.5 Bead Making

The function of the bead is to provide a proper seal between the tire and the wheel rim when a tire is mounted on the rim and inflated. Bead rubber compounds produced in mixing are used to coat bead wires. In addition, beads may be dipped in a cement solution then air dried for the purpose of providing a tacky surface for tire adhesion prior to curing. The completed beads are supplied to the builder.

For typical passenger and light duty truck tire production, brass-plated bead wire is received as strands on large spools. Several strands are bundled and the bundles of wires are passed through an extrusion die and given a coating of rubber. The rubber coated wire is then wound into a hoop of specific diameter and thickness, racked, and sent to the tire building machine. In some cases, a cement may be applied to the finished bead. Note that the tire bead and final size of the bead is a function of the tire being produced. Off road tire beads may be as thick as one to two inches in diameter and may have several wire combinations when tire building is completed.

3.1.6 Cementing and Marking

Cementing operations are used at various stages in the tire building process to maintain or achieve rubber compound “tackiness”. Tire components are not immediately used in the tire building process and as a result, the cut and exposed edges of the tire component (e.g., tread end) may develop a natural film preventing the needed temporary adhesion during the tire building process. To avoid separation of the rubber components after building and prior to curing, cements (adhesives or solvents) may be used to improve the adhesion of different components to each other during the tire building process. Traditionally cements have been used in the bead building process, applied to extruded tread stock (tread end cementing for cut treads and undertread cementing for retreads and certain other tread and sidewall stocks), and applied directly at tire building machines. It is important to note that cement usage can vary significantly among facilities depending on the type of tire being manufactured and the process being utilized.

For example, more cement/solvent addition may be used at an off road tire building station than at a passenger car tire building station due to the number of components and operator/builder envolvement.

Marking inks are used at various stages of the process to aid in the identification of the components being managed. Typically marking inks are applied to extruded tread stocks to aid in the identification and handling of cured tires. Again, it is important to note that marking practices can vary significantly among facilities.

3.1.7 Cutting and Cooling

The various tire components manufactured in component preparation must be cooled and cut prior to introduction into tire building. Typically the processing of the rubber compounds generates heat that causes an increase in rubber temperature. If this temperature is not controlled properly the compound may begin to cure prematurely thus rendering it unusable. Rubber from mixing, milling, and extruding operations may be placed onto long conveyor belts that, through the application of cool air or cool water, lowers their temperature. Components are also required to be cut and trimmed to size for use in the tire building process. The cutting operations of some components is facility and company controlled and specified and additionally differ by equipment and tire type. In some facilities tire treads may be cut into a specified length and racked ("booked") for delivery to the tire builder. Other facilities may have a continuous roll of tire tread component that is cut to length at the tire building station. Where a continuous roll is used to supply components to the tire building station, tread end cementing is not used. The primary purposes of either the edge cementing/adhesive addition during automatic cutting or the tire builder cut at tire building station is to provide a surface condition that allows the component to adhere to the sub-component or adjoining component. Some compounding used for the various components do not require cement to provide this precurring adhesion.

3.1.8 Tire Building

Tire components from bead making, extruding, and calendering are moved to the component assembling area. The assembly of various tire components is referred to as tire building. The two main mechanical components (primarily used in the passenger and light duty truck tire production facilities) of the tire-building operation are the tire carcass build-up drum and the tread application drum. These mechanical components consist of collapsible cylinders shaped like wide drums that can be turned and controlled by the tire builder. The tread application may occur next to the carcass drum operation, at a different location, or on the carcass drum location by sliding the tread over the open end of the drum without removing the carcass. Other tire types may only use the main drum where all component build-up is done at one station. This is typical for off road and other large tires such as in the aircraft tire industry. Tire building is a combination of mechanical equipment and manual operator application of components. In some instances, automated tire building stations are entering the industry and are part of current facilities. These “automated” tire building machines perform many of the manual operations associated with tire building but still require an operator to perform some of the manual operations.

The typical tire building process begins with the application of a thin layer of special calendered rubber compound, called the innerliner, to the drum. Next, plies are placed on the drum one at a time. The cords (calendered stock - rayon, nylon, polyester and related fabrics coated with rubber) are laid in alternate direction in each successive ply. This step is followed by a process of setting the beads in place. The plies are turned up around the beads and incorporate the beads into the tire. Chafer (extruder) stock from extruding or calendering is added if needed. Belts (metal or fabric calendered stock), if any, are then applied. Finally, the tread and the sidewalls are added to complete the tire. The tire may be "stitched" (i.e., application of site specific mechanical or manual rollers over component edges of the “green” tire) under pressure to remove air from between the components and provide an initial bind to the components.

The drum is then collapsed and the uncured (green) tire transferred to the green tire spraying operation. Cement and/or solvent usage during tire building will vary significantly among facilities and type of tire being produced. Information and observations indicate that radial tire production typically involves limited use of cements and solvents. Also, as tire size, and thus number of components, increase, solvent and cement usage typically increases due to the increased time required to apply components during tire building.

3.1.9 Green Tire Spraying

In preparation for curing, the uncured green tire may be coated with a lubricant (green tire spray). The lubricating spray is either a solvent-based or a water-based silicone. The function of the green tire spray is to ensure the cured tire does not stick to the curing mold during extraction of the tire after curing.

3.1.10 Tire Curing

Regardless of the tire type or size, green tires are loaded into tire presses and cured (vulcanized) at high temperature and pressure. The curing presses are typically autoloading and autoextracting operations. Curing also is accomplished in heated compression molds (platen presses) and steam heated pressure vessels (autoclaves). Although the larger off road tire curing operations are similar to the typical passenger and light duty truck tire curing operations, the operation is much larger and curing times are typically much longer.

Prior to curing, the green tire has a cylindrical (bias tires) or toroidal (radial tires) shape. The green tires are loaded into the curing press and an internal rubber bladder is inflated inside the tire. This forces the green tire exterior into the mold causing it to assume the characteristic doughnut shape. As the bladder inflates the mold is closed. Steam heat is applied to the outside of the tire through the mold and to the inside by the bladder. After a time-, pressure-, and temperature-controlled cure, the press is cooled, the bladder is deflated, and the tire, complete with grooved tread and raised lettering, is extracted.

During the curing process, the polymer chains in the rubber matrix cross-link to form a final product of durable, elastic, thermoset rubber. Increasing the number of cross-links in the rubber matrix gives rubber its elastic quality. The objective of the curing process is to convert the rubber, fabric, and wires into a tough, highly elastic product while bonding the various parts of the tire into one single unit.

3.1.11 Tire Finishing

Finishing the tire may involve one or more, or none, of the following operations: trimming, white sidewall grinding, buffing, balancing, blemish painting, whitewall/raised letter protectant painting, and quality control inspections. Other tire finishing and enhancements may include the application of a sticky material sprayed into the inside of the finished tire as a puncture resistant attribute.

3.1.12 Puncture Sealant

In addition to the basic steps typically used in tire manufacture, an additional operation, application of a puncture sealant, exists at one tire manufacturing facility. The operation coats the inside of the finished tire with puncture proofing material, and is the final step in the tire production process at this facility prior to shipping the final product.

The processes listed above are summarized in Table 3 along with known control devices or emission reduction techniques for particulate matter HAP (PMHAP) and volatile organic HAP (VOHAP).[2,4,5]

TABLE 3. TECHNIQUES FOR CONTROLLING EMISSIONS FROM TIRE MANUFACTURING

Process	Function	VOHAP Controls	PMHAP Controls
Mixing	Mixes rubber and additives into single rubber compound	None	Fabric filters
Milling	Forms sheets or strips of warm rubber compound	None	None
Extruding	Squeezes compound into desired shapes	None	None
Calendering	Combines fabric or wire with rubber compound	None	None
Cementing	Provides tire component adhesion during building	Permanent total enclosure with incineration, Incinerators, Cement reformulation, Cement elimination	
Bead Making	Forms tire bead from wire and rubber compound	Reformulation of Cement	None
Cooling and Cutting	Cools the rubber compound after milling and extruding and sizes the tire components	None	None
Tire Building	Assembles tire components into a carcass or green tire	Cement reformulation,	None

		Cement elimination	
Green Tire Spraying	Lubricates tire for release from curing	Lubricant reformulation	Baffle plates in the stack
Curing	Heats and forms the commercial tire product	None	Electrostatic precipitators
Finishing	May include grinding to remove white side wall protective strip or eccentricities from the tire, paint application for grinding or blemish repairs, buffing, balancing, and quality control	None	Fabric filters, Wet scrubbers, Cyclones
Puncture Sealing	Coats the inside of the finished tire with puncture proofing material	Permanent total enclosure with carbon adsorption, Solvent reformulation	None

4.0 EMISSIONS

Emissions from tire manufacturing originate from two general sources: (1) the rubber compounds themselves; and (2) solvents used for cement, inks, or lubrication. The emissions from these two general sources include both PMHAP and VOHAP.

4.1 Particulate Emissions

Particulate emissions occur primarily from mixing and grinding. Particulate emissions have been identified in the milling process, however the quantity of these emissions appear to be small. Additional review of the emissions of particulate at milling will be done. Typical controls of particulate emissions include cyclones, fabric filters, settling chambers, mist eliminators, wet scrubbers, and electrostatic precipitators (ESP). Of these, fabric filters are predominately installed at most facilities and have the highest control efficiency (98 - 99.9 percent) of the devices listed.[4,5] One rubber tire manufacturing facility has been identified that currently controls particulate emissions (i.e., the State of Virginia has characterized the emissions as particulates, however the emissions may be condensable semi-volatiles) from some of its curing lines with ESP. This facility desires to discontinue the use of the ESP on their curing process units and has requested the State air pollution control agency to revise their air permit to remove the condition requiring their use.

Limited quantitative data is currently available regarding particulate emissions from rubber tire production. In response to a need for documented emission factors (EF) for the rubber industry, the RMA developed EF for the commonly used rubber manufacturing processes and rubber compounds, including tire manufacture. These EF, currently being considered by the EPA for inclusion in AP-42, include EF for metals and particulate matter for mixing and compounding, extruding, and grinding operations. The RMA indicates that metals are expected to be emitted in the mixing process, however, analytical results on extruder emissions indicated that the metal emissions detected may be within the margin of error for the analytical methodology.[2]

Based on the currently available data it is not possible to conclusively state that total particulate matter serves as a reliable surrogate for HAP emissions, or to accurately quantify particulate emissions for a rubber tire manufacturing facility. However, based on the fact that (1) particulate emissions are currently controlled from mixing, emissions that may be associated with the mixing unit from milling or pelletizing, grinding, and in one case, curing operations; (2) the RMA has developed EF for particulate emissions as well as metals; and (3) the RMA expects metals to be detected in the particulate matter from mixing operations, the EPA believes that it is necessary and prudent to further investigate particulate emissions from tire manufacturing.

As a result of the limited availability of information regarding particulate emissions from tire manufacturing, the remainder of this chapter will address VOHAP emissions. However, particulate emissions will be addressed in chapter 5.0, Existing Industry Emission Controls, of this document.

4.2 VOHAP Emissions

VOHAP emissions from rubber tire manufacturing originate from three general processes: (1) the mixing and milling of rubber compounds, where these compounds are manipulated and generate heat; (2) the incorporation of solvent and cementing liquids on components for tire building, such as beads, undertreads, and sidewalls, and the use of solvents in lubricating the green tire; and, (3) curring.

The emissions from rubber compounds were quantified by a 1994 study commissioned by the RMA.[6] That study identified and reported probable air emissions of the 188 HAP listed in Title III of the Clean Air Act as amended in 1990. The RMA also established EF for the seven most common rubber compounds used in the manufacture of all types and sizes of rubber tires. These emissions arise chiefly from inherent constituents of rubber and other solids used to produce tires. Prior to this study little data from quantification of emissions from rubber compounds and processes in tire manufacturing were available. The study concentrated on rubber compounds and did not include other solvent use (e.g., solvents contained in cement).

Solvent emissions are primarily from cementing formulations and lubricants such as mold release agents. Additional emission areas are bead dipping, final repair, and puncture sealant operations. They vary among facilities because of different techniques used by different manufacturers. Even within a single manufacturer, different facilities may have substantially different solvent use because of the type or size of tire produced, and differences in equipment and work practices. Because these work practices are site-specific and usually regarded as proprietary, the RMA study could not individually account for them.

Total emissions for tire manufacturing are becoming available as a result of the recent availability of better EF from the RMA as well as the greater detail required by Title V permit applications. It appears that all high volume producers of passenger and light duty truck radial tires examined to date are major sources with respect to HAP emissions based on potential to emit after control, and would be major sources even if that determination were based on actual emissions. Although high volume producers of passenger and light duty truck tires appear to be major with respect to HAP emissions, the weight of rubber produced has a better correlation with major status than does the number, or type, of tires produced. For example, the production of “off-road” tires, though low in number, uses a large mass of rubber and may result in major source level HAP emissions.

4.2.1 Data Available for Quantification of VOHAP Emissions

Because rubber tire manufacturing has such a broad affected community, it is desirable to estimate VOHAP emissions from rubber tire manufacturing facilities using a common denominator. This document estimates VOHAP emissions on a pound of HAP emitted per pound of rubber processed basis. Many standards, including the NSPS for tire manufacturing, are expressed in units of "pollutant mass per item produced." Wide agreement on the weight of a standard tire and the amount of rubber in that tire renders these two emission estimation methods for the production of passenger tires equivalent. However, a standard VOHAP emission per tire is not applicable when assessing all facilities
(i.e., those that manufacture products other than passenger and light duty truck tires) in the category.

The RMA developed EF for estimating HAP emissions from rubber compounds on a pound HAP emitted per pound rubber processed basis from the tire manufacturing process. These factors can be used in a wide range of facilities, since rubber compounds in use are limited and relatively homogenous across the industry. However, because cement formulation and use, and therefore VOC and VOHAP emissions from cementing, vary widely among facilities, specific and total VOHAP emissions from solvent and cement use in a rubber tire manufacturing facility have traditionally been calculated by mass balance. Also, cement formulation and use is considered to be proprietary information by most tire manufacturers, and thus is available only on a confidential basis.

Estimation of emissions for each process requires two steps. The first step is to use the RMA EF for calculating VOHAP emissions from rubber compounds for each unit process. The second step is to apply mass balance techniques for solvent use at each unit process. The sum of these two steps for a given unit process yields the total VOHAP emissions for that process. Much of the data for this approach may not be recorded on a process unit basis or is considered by the industry to be proprietary and thus are not readily available. Therefore, for the purpose of this document, emissions from each process unit were estimated using a model facility designed based on currently available information and engineering judgement.

Recently available Title V permit applications for rubber tire manufacturing facilities provide maximum potential throughput values for specific process units. Because most rubber tire manufacturing facilities operate continuously, potential throughput is approximately equal to actual throughput. Therefore permit data can be used in conjunction with engineering judgement to allocate VOHAP emissions to specific process units. To calculate EF for a rubber tire manufacturing facility, a model facility was developed using this information. This model facility was then used in conjunction with the RMA-developed EF to develop facility-wide VOHAP EF (see section 4.2.3, Derivation of VOHAP EF Using a Model Facility and EF Developed by the RMA, of this document).

4.2.2 Derivation of VOHAP Emission Factors Based on Reported Emissions at Two Rubber Tire Production Facilities

Available VOHAP emission inventories from rubber tire manufacturing facilities were reviewed for the purpose of developing emissions factors. Two facilities with the most current emission inventories, referred to as Facilities A and B in this document, were identified.[4] These emission inventories were used because: (1) more complete data were available for them than for other facilities; (2) the EPA has recently surveyed them; and (3) one facility has aggressively reduced VOHAP emissions through reformulation and process changes, while the other facility has been less aggressive in VOHAP reduction. Both facilities manufacture passenger and light duty truck tires.

The VOHAP emissions from all solvents and cements used in tire building, cleaning, and repair are available from the emissions inventories of Facilities A and B. Facility A reported that 48.0 tons of VOHAP were emitted in 1997, and 58,600 tires were produced per day for 311 days, for an average 0.000212 pounds VOHAP emitted per pound rubber processed. The average tire produced at Facility A in 1997 contained 24.9 pounds rubber.[7] Facility B indicated 182 tons of VOHAP were emitted in 1996, and 36,700 tires were produced per day for 354 days for an average of 0.00152 pounds VOHAP emitted per pound rubber processed. The average tire produced at Facility A in 1996 contained 18.4 pounds rubber.[8] Table 4 summarizes the VOHAP emissions from Facilities A and B.

4.2.3 Derivation of VOHAP Emission Factors Using a Model Facility and Emission Factors Developed by the RMA

The RMA developed EF for VOHAP emissions on a pound HAP emitted per pound rubber processed basis. The EF are associated with specific process units in tire manufacturing. With the RMA-developed EF as a basis, EF for predicting emissions from an entire rubber tire production facility were developed by estimating VOHAP emissions from each process unit. Two steps were involved in estimating the VOHAP emissions from each process unit. First, the RMA EF for VOHAP were applied to the mass of rubber processed by each process unit. Second, the amount of total solvent emissions from each process unit resulting from cementing where solvent VOHAP is present was estimated.

According to the results of the RMA testing no VOHAP emissions from the cementing operation conducted at a tire manufacturing facility were specifically identified or accounted for in the EF.[6] The EF are conservative representations of VOHAP emissions from rubber compounds alone. Thus, it is reasonable to assume that the VOC (and associated HAP component) emissions from cementing or solvent used in tire building are attributable solely to cement solvents. Another process unit where emissions

TABLE 4. DERIVED VOHAP EMISSION FACTORS BASED ON REPORTED EMISSIONS FROM TWO PASSENGER AND LIGHT DUTY TRUCK TIRE PRODUCTION FACILITIES

Facility	Tires per day	Days	Tires per year	Tons VOHAP reported in 1994	Pounds rubber per tire	Pounds VOHAP emitted per pound rubber
A	58,600	311	18,200,000	48.0	24.9	0.000212
B	36,700	354	13,000,000	182	18.4	0.00152
Average	----	----	----	----	----	0.000866

NOTE: The information on these facilities was relatively available and provide a basis analyses applicable to the whole source category on a pounds of VOHAP emitted per pound of rubber processed. This P-MACT document does not intend to suggest that production of tires other than passenger and light duty truck tires have similar emissions on a process basis accounting.

arising from solvent in cement are expected is molding and curing. No adequate database characterizing cement use by process unit currently exists.[9] Solvents used in rubber tire manufacturing are primarily associated with cementing and tire building. Others are used in bead dipping operations and in final repair. Traditionally, all solvents have been assumed to be emitted (100 percent) to the atmosphere for purposes of State permitting and emission inventories. Therefore, for this analysis, engineering judgement was used for characterizing cement and other solvent use in a model facility. Technical data developed for use in the model facility are detailed in the following sections.

It should be noted that only process units downstream of cement solvent introduction will have emissions arising from cementing and solvent application (e.g., bead dipping). For example the mixers, used in a process prior to cementing, have no emissions associated with solvents in cement. Also noted is that the RMA VOHAP EF for curing may include emissions associated with the cement solvent bound to the rubber. The RMA speculates that 8 percent of added solvent in the plant is absorbed in the non-cured rubber. Thus this quantity of solvent may be available for release during curing).

4.2.3.1 Allocation of Cement Solvent Emissions from Process Units

Many of the process units following the application of cements and other process solvents will have VOHAP emissions as a result. In the absence of an adequate database for the apportioning of cement solvent VOHAP emissions by process unit, the RMA has provided allocation estimates for cement solvent emissions. These estimates are based on information gained as a result of previous studies and further refined by the RMA. Approximately 80% of the cement solvent is emitted during the cementing process, 12% of the cement solvent is emitted during the time the component is being transferred to tire assembly and during the tire assembly process itself, and the remaining 8% of the cement solvent becomes absorbed into the rubber tire component and may not be emitted for periods exceeding 24 hours.[2,10] These solvent emissions allocations represent a typical tire facility and may vary among facilities due to process differences. To account for the potential cement solvent emissions in this P-MACT analysis, the EPA assumed that 80% of the cement solvent is emitted during the cementing process, 12% of the cement solvent is emitted during the tire building process, and 8% of the cement solvent is emitted during the curing process.

All tire building stations in the industry have solvent application capability and availability. Additional solvent use (and emissions) for temporary tire component adhesion during tire building is a function of the type of tire being produced and the tire production company. For example, off road tires require a significant buildup of rubber components (e.g., up to 2 tons of rubber) and also require the most manual labor to construct. Thus the additional time and number of components required during the tire building operation necessitates increased solvent and cement use during the tire building process.

4.2.3.2 Cement Formulation

The VOHAP content of cement used in tire manufacturing has decreased over time. In addition, the tire manufacturing industry has indicated that tire manufacturing processes are, in large part, proprietary in nature. In particular, different companies use different formulas in the manufacture of tires. Types and quantities of materials, including solvents, vary, and are closely-guarded trade secrets. The basic cement formulation may vary among companies and facilities, however the basic generic form of the compound is a low solids naptha-butyl-toluene type cement. In some instances the individual company or facility has taken aggressive steps to eliminate HAP solvents or substitute non-HAP solvents for HAP solvents in the cement, or have eliminated certain cementing operations. Given the proprietary nature of specific plant or company cement/solvent formulations, they are not currently available to the EPA. To account for VOHAP emissions due to cementing it was necessary to estimate a cement formulation for use in the model facility based on available information.

The most recent available data on cement formulation was supplied by Facilities A and B. The cement used at Facility A is approximately 90% volatiles by weight. However the cement has been reformulated to replace HAP with non-HAP, thus eliminating potential HAP emissions. The cement used at Facility B is 90.5% volatiles by weight, and has an overall VOHAP content of 39.5%. Thus the HAP content of Facility B's cement is approximately 43.6% (39.5% divided by 90.5%).

The EPA realizes that many facilities within the tire manufacturing industry have reformulated cement to replace VOHAP solvents with non-HAP solvents. The EPA has also been advised by industry representatives that cement VOHAP content may range from 0% to 90%, depending on the tire company or manufacturing plant in question. However, since that reformulation data is not currently available to the EPA, and cement VOHAP content may be as high as 90%, for the purpose of this P-MACT document the value for VOHAP content in the cement solvent that will be used is 90%. When more current data becomes available, the EPA will consider revising this value.

4.2.3.3 Cement Use

Cement use is needed in conjunction with cement VOHAP content to determine VOHAP emissions by mass balance. The most recent available data on cement use was reported by Facility B. The annual cement use reported by facility B in 1996 (rounded to three significant figures) was 506,000 pounds from the production of 36,700 tires per day, 354 days per year, or 0.0389 pounds cement per tire. Using the cement use per tire value from Facility B and the model facility's tire production of 40,000 tires per year, 360 days per year, the annual cement use for the model facility is calculated to be 560,000 pounds cement per year.

4.2.3.4 Estimated VOHAP Emissions from a Model Tire Production Facility

Tables 5, 6, 7, and 8 show the uncontrolled VOHAP emissions from a model tire production facility, using mean and maximum RMA EF, respectively. These figures assume a facility

TABLE 5. EMISSIONS ESTIMATES FOR VOHAP FROM CEMENT AND RUBBER COMPOUNDS: MEAN RMA TIRE COMPOUND EMISSION FACTORS AND HOT EXTRUSION

Process Unit	Rubber Processed (million lb)[a]	RMA Organic HAP Factor (lb HAP/lb rubber)	VOHAP Emitted from Rubber (lb)	Cement Used (lb/yr)[f]	VOHAP Emitted from Cement (lb)[k]	Total VOHAP Emitted (lb/yr)	Total VOHAP Emitted (tons/yr)
Mixing	324	3.60E-05	11,700	0	0	11,700	5.9
Milling	648[b]	1.75E-05	11,300	0	0	11,300	5.7
Extrusion	194[c]	2.01E-05	3,900	0	0	3,900	2.0
Calendering	130[d]	5.11E-05	6,640	0	0	6,640	3.3
Cementing	324	0.00E+00	0	560,000[g,h])(i)	403,000	403,000	202.0
Building	324	0.00E+00	0	0[i]	60,500	60,500	30.3
Curing	324	7.05E-05	22,800	0[j]	40,300	63,100	31.6
Finishing	3.24[e]	1.12E-03	3,630	0	0	3,630	1.8
Total	----	----	60,000	----	504,000	564,000	283.0

a - Assumes 22.5 lbs. rubber/tire, 40,000 tires/year, and 360 days/year operation.
b - Assumes 2 passes through the milling unit.
c - Assumes 60% of the rubber is extruded into treads.
d - Assumes 40% of the rubber is calendered into ply.
e - Assumes a 1% finishing loss.

f - Cement use is derived from cement use reported by Facility B.
g - All cement is applied in the cementing process.
h - Assumes 80% of the cement solvent applied is emitted at the cementing process.
i - Assumes 12% of the cement solvent applied is emitted at the building process.
j - Assumes 8% of the cement solvent applied is emitted at the curing process.
k - Assumes that 90% of the cement solvent emitted is VOHAP.

TABLE 6. EMISSIONS ESTIMATES FOR VOHAP FROM CEMENT AND RUBBER COMPOUNDS: MAXIMUM RMA TIRE COMPOUND EMISSION FACTORS AND HOT EXTRUSION

Process Unit	Rubber Processed (million lb)[a]	RMA Organic HAP Factor (lb HAP/lb rubber)	VOHAP Emitted from Rubber (lb)	Cement Used (lb/yr)[f]	VOHAP Emitted from Cement (lb)[k]	Total VOHAP Emitted (lb/yr)	Total VOHAP Emitted (tons/yr)
Mixing	324	5.91E-05	19,100	0	0	19,100	9.6
Milling	648[b]	2.53E-05	16,400	0	0	16,400	8.2
Extrusion	194[c]	3.52E-05	6,830	0	0	6,830	3.4
Calendering	130[d]	8.55E-05	11,100	0	0	11,100	5.6
Cementing	324	0.00E+00	0	560,000[g,h]	403,000	403,000	202.0
Building	324	0.00E+00	0	0[i]	60,500	60,500	30.3
Curing	324	1.28E-04	41,500	0[j]	40,300	81,800	40.9
Finishing	3.24[e]	1.12E-03	3,630	0	0	3,630	1.8
Total	----	----	98,600	----	504,000	602,000	302.0

a - Assumes 22.5 lbs. rubber/tire, 40,000 tires/year, and 360 days/year operation.
b - Assumes 2 passes through the milling unit.
c - Assumes 60% of the rubber is extruded into treads.
d - Assumes 40% of the rubber is calendered into ply.
e - Assumes a 1% finishing loss.

f - Cement use is derived from cement use reported by Facility B.
g - All cement is applied in the cementing process.
h - Assumes 80% of the cement solvent applied is emitted at the cementing process.
i - Assumes 12% of the cement solvent applied is emitted at the building process.
j - Assumes 8% of the cement solvent applied is emitted at the curing process.
k - Assumes that 90% of the cement solvent emitted is VOHAP.

TABLE 7. EMISSIONS ESTIMATES FOR VOHAP FROM CEMENT AND RUBBER COMPOUNDS: MEAN RMA TIRE COMPO UND EMISSION FACTORS AND COLD EXTRUSION

Process Unit	Rubber Processed (million lb)[a]	RMA Organic HAP Factor (lb HAP/lb rubber)	VOHAP Emitted from Rubber (lb)	Cement Used (lb/yr)[f]	VOHAP Emitted from Cement (lb)[k]	Total VOHAP Emitted (lb/yr)	Total VOHAP Emitted (tons/yr)
Mixing	324	3.60E-05	11,700	0	0	11,700	5.9
Milling	0[b]	1.75E-05	0	0	0	0	0.0
Extrusion	194[c]	2.01E-05	3,900	0	0	3,900	2.0
Calendering	130[d]	5.11E-05	6,640	0	0	6,640	3.3
Cementing	324	0.00E+00	0	560,000[g,h]	403,000	403,000	202.0
Building	324	0.00E+00	0	0[i]	60,500	60,500	30.3
Curing	324	7.05E-05	22,800	0[j]	40,300	63,100	31.6
Finishing	3.24[e]	1.12E-03	3,630	0	0	3,630	1.8
Total	----	----	48,700	----	504,000	552,000	277.0

a - Assumes 22.5 lbs. rubber/tire, 40,000 tires/year, and 360 days/year operation.
b - Assumes no milling.
c - Assumes 60% of the rubber is extruded into treads.
d - Assumes 40% of the rubber is calendered into ply.
e - Assumes a 1% finishing loss.

f - Cement use is derived from cement use reported by Facility B.
g - All cement is applied in the cementing process.
h - Assumes 80% of the cement solvent applied is emitted at the cementing process.
i - Assumes 12% of the cement solvent applied is emitted at the building process.
j - Assumes 8% of the cement solvent applied is emitted at the curing process.
k - Assumes that 90% of the cement solvent emitted is VOHAP.

TABLE 8. EMISSIONS ESTIMATES FOR VOHAP FROM CEMENT AND RUBBER COMPOUNDS: MAXIMUM RMA TIRE COMPOUND EMISSION FACTORS AND COLD EXTRUSION

Process Unit	Rubber Processed (million lb)[a]	RMA Organic HAP Factor (lb HAP/lb rubber)	VOHAP Emitted from Rubber (lb)	Cement Used (lb/yr)[f]	VOHAP Emitted from Cement (lb)[k]	Total VOHAP Emitted (lb/yr)	Total VOHAP Emitted (tons/yr)
Mixing	324	5.91E-05	19,100	0	0	19,100	9.6
Milling	0[b]	2.53E-05	0	0	0	0	0.0
Extrusion	194[c]	3.52E-05	6,830	0	0	6,830	3.4
Calendering	130[d]	8.55E-05	11,100	0	0	11,100	5.6
Cementing	324	0.00E+00	0	560,000[g,h]	403,000	403,000	202.0
Building	324	0.00E+00	0	0[i]	60,500	60,500	30.3
Curing	324	1.28E-04	41,500	0[j]	40,300	81,800	40.9
Finishing	3.24[e]	1.12E-03	3,630	0	0	3,630	1.8
Total	----	----		----	504,000	586,000	294.0

a - Assumes 22.5 lbs. rubber/tire, 40,000 tires/year, and 360 days/year operation.
b - Assumes no milling.
c - Assumes 60% of the rubber is extruded into treads.
d - Assumes 40% of the rubber is calendered into ply.
e - Assumes a 1% finishing loss.
f - Cement use is derived from cement use reported by Facility B.

g - All cement is applied in the cementing process.
h - Assumes 80% of the cement solvent applied is emitted at the cementing process.
i - Assumes 12% of the cement solvent applied is emitted at the building process.
j - Assumes 8% of the cement solvent applied is emitted at the curing process.
k - Assumes that 90% of the cement solvent emitted is VOHAP.

produces 40,000 tires per day, 360 days per year, a tire weight of 25 pounds with 22.5 pounds rubber, and that 60 percent of the rubber is extruded into treads while 40 percent is calendered into ply.[11] Grinding losses are assumed to be one percent. Emissions from bead coating and mold release are considered negligible due to the adoption of VOHAP-free substances for those operations. Emissions from finishing and painting for the model plants are included in the data for cementing. Both bead coating and finishing may be added to this analysis if future data indicates. Adhesives are not applied at curing, but cement solvent from prior process units is evaporated there by elevated temperatures. Two passes through a warm-up mill are assumed for hot extrusion, and no milling is assumed for cold extrusion.

4.2.4 Summary of Emission Estimation Factors

Table 9 displays the VOHAP emission estimation factors for determining VOHAP emissions from rubber tire manufacturing facilities in pounds VOHAP emitted per pound of rubber processed. The EF derived from reported VOHAP emissions were based on VOHAP emissions reported by facilities A and B. The mean and maximum EF were derived using process unit EF developed by the RMA in conjunction with a model hot extruder facility developed based largely on engineering judgement. Mass balance was used to account for cement-related solvent emissions. A hot extruder was selected for this model facility because, compared to cold extrusion, hot extrusion involves one or more milling steps prior to extrusion, and this milling is a source of VOHAP emissions. Therefore, the selection of a hot extruder provides a more conservative estimate of emissions. In the absence of better available information, these EF would

TABLE 9. ESTIMATED VOHAP EMISSION FACTORS FOR RUBBER TIRE PRODUCTION FACILITIES

Data Source	VOHAP emitted (lb VOHAP/lb rubber)
Emission factor derived from emissions inventories reported by Facilities A and B[a]	0.000866
Emission factor derived using a model hot extrusion facility and mean process unit emission factors developed by the RMA[b]	0.00174
Emission factor derived using a model hot extrusion facility and maximum process unit emission factors developed by the RMA[b]	0.00186

a - Derived from emissions inventory data for Facilities A (1997 data) and B (1996 data).

b - Derived from RMA process unit emission factors applied to a model hot extrusion facility developed based largely on engineering judgement.

be used to determine if a rubber tire production facility meets the criteria of a major source.

5.0 EXISTING INDUSTRY EMISSION CONTROLS

The existing control devices in the rubber tire manufacturing industry were typically installed to control criteria pollutants or for nuisance abatement. The removal efficiencies described in this document are typical for total particulate or volatile organic compounds (VOC), and may differ for the control of HAP.

5.1 PMHAP Emission Controls

Emission controls for particulate emissions include cyclones, fabric filters, settling chambers, mist eliminators, wet scrubbers, and ESP. Fabric filters are predominately installed on the mixers, and fabric filters, wet scrubbers, and cyclones are installed on grinding operations. One rubber tire manufacturing facility has been identified that currently controls particulate emissions (i.e., the State of Virginia has characterized the emissions as particulates, however the emissions may be condensable semi-volatiles) from some of its curing lines with electrostatic precipitators (ESP).

Particulate matter HAP are associated primarily with the chemical make up of the rubber compound. Individual PMHAP may be associated with the compound and mixing process, however this is not the case for grinding operations from which particulate matter would be cured rubber matter. Individual PMHAP released at grinding should not be encountered.

5.2 VOHAP Emission Controls

Since the publication of the NSPS, the rubber tire manufacturing industry has made significant advances in lowering VOHAP emission by reformulating cement to substitute HAP solvents with non-HAP solvents, reducing solvent use, and minimizing the number of tire components that are cemented and the tire component area on which cement is applied. For example, some facilities have ceased cementing undertread, tread ends, and sidewalls. Complete cement elimination or solvent reformulation (i.e., substituting a non-HAP for a HAP, for example hexol for hexane) would result in the elimination of 100 percent of VOHAP emissions from cementing, but no reduction of VOHAP emissions from rubber compounds.

Emission reduction controls for VOHAP exhibited in the rubber tire manufacturing industry include catalytic and thermal incinerators (primarily associated with tread end, sidewall, and undertread cementing operations) and solvent reformulation/elimination. In addition, one tire manufacturing facility has been identified that operates a puncture sealant line. This facility controls VOHAP emissions from the puncture sealant process with a permanent total enclosure vented to carbon adsorbers.

5.3 MACT Floor

The EPA has initially identified 43 rubber tire manufacturing facilities in the United States.[2] Section 112 of the Act provides that the MACT floor for existing sources shall be no less stringent than the level of HAP reduction corresponding to the average of the best performing 12 percent of potentially affected sources. Twelve percent of 43 is 5.16, so for the purpose of this P-MACT, the MACT floor is considered to be the five best performing sources. Section 112 of the Act provides that the MACT floor for new sources shall be no less stringent than the level of HAP reduction corresponding to the best controlled similar source.

The MACT floor is based on information available to the EPA Administrator. To date, information has been gathered from the RMA, State files, existing literature, site visits to rubber tire manufacturing facilities (passenger and light duty truck, aircraft, large off-road, and heavy truck tire facilities), and HAP emissions inventories from rubber tire manufacturing facilities. This information has been used to characterize the industry as it exists today and to make a preliminary estimate of the MACT floor.

The EPA has structured the MACT floor determinations in this P-MACT document to specify emissions control technologies and emissions reduction efficiencies for individual process units within the tire manufacturing industry. In addition, the EPA is considering providing tire manufacturing facilities the opportunity to achieve an alternative facility-wide emission standard like that contained and offered in NSPS Subpart BBB. Such a reduction would likely be written in terms of mass of emission per pound of rubber compound processed (see section 7.6, Alternative Emission Standard, of this document).

5.3.1 MACT Floor for PMHAP

Based on information currently available to the EPA, the five best performing facilities have fabric filter baghouses installed to control particulate emissions from the mixing and grinding process units. These filters have been reported to have emission reduction efficiencies of 98 - 99.9 percent for particulates.[4,5] The RMA has indicated that they believe that a very efficient baghouse may be able to achieve 99% emissions reduction at one type of tire manufacturing plant, but different conditions at another plant may cause the emissions reduction efficiency to be lower, although a specific emissions reduction efficiency was not stated.[2] In addition, the RMA has indicated that the quantity and characteristics of emissions from the grinding process units vary, depending on process differences such as the type of equipment used, the speed of the grinder, and the texture of the grinding medium. Also, the RMA has suggested that the grinding process units may be insignificant sources for HAP emissions.[2] The EPA considers that a well designed baghouse control is capable of achieving 98 plus percent removal efficiency or particulate reductions by weight.

The apparent MACT floor for new and existing major sources of PMHAP would appear to be the equivalent of fabric filter add-on controls for the mixing and compounding process units. Although the level of control achieved by fabric filters have not been determined, it is possible to accurately determine the level of control that can reasonably be achieved by the fabric filter baghouses controlling the mixing and compounding process units. Further, it is possible to determine if the particulate emissions are representative of HAP emissions. The identification of this control application indicates that the systems are currently installed on the mixing and compounding areas at tire facilities. Design and testing information could be made available to show the current reduction of particulates. Observations and discussions with the facility personnel indicate that these controls are the control of choice and subsequent information is forth coming. The logical approach is to assume that HAP particulates are associated with compounding and released during the mixing. Section 7.3, Particulate Emissions, of this document identifies and further discusses the issues and uncertainties associated with particulate emissions from tire manufacture.

One rubber tire manufacturing facility has been identified that currently controls particulate emissions from some of its curing lines with ESP. Initial diagnostic tests, conducted to support State Title V permitting, were performed by the facility for the purpose of proving that the ESP were not necessary for controlling PM from the curing process in order to meet a State minor modification emission level for PM-10. The results of these tests were variable, indicating the control efficiency of the ESP between 0% and 60%.[2] Additional testing has been discussed by the company and the State of Virginia to assess PM emissions for permitting requirements.

Since only one known tire manufacturing facility has installed ESP for controlling particulate emissions on the curing units, the effectiveness of that control is limited, and the possibility that in the near-term the State may allowed the facility to discontinue use of the ESP, the EPA believes that it is not prudent to consider these controls in the P-MACT floor development at this time. However, the EPA will continue to assess this situation and, if the ESP are determined to be effective at PM (and subsequently PMHAP fractions) removal, will consider them in the MACT floor development.

5.3.2 MACT Floor for VOHAP

Of the VOHAP sources, only the cementing operations (undertread, sidewall, bead preparation, and tread cementing) and the puncture sealant line are controlled by add-on control devices. The single existing puncture sealant line is controlled by a carbon adsorber operating at 93 percent capture and removal efficiency.[4] Cementing operations are controlled by incinerators at five facilities. At least two of these five cementing operations are controlled by totally enclosed incinerators. These incinerators have been reported to have emission reduction efficiencies of greater than 95 percent for VOHAP.[4]

The RMA has indicated that the best designed enclosure will only capture approximately 75% of the total VOHAP that are being volatilized from the cementing operation. This is predicated on the fact that only a portion of the cement applied is emitted at the cementing operation (80 percent). The remainder is emitted after the cemented rubber compound leaves the cementing operation and thus is not available for capture by the enclosure.[2] Based on the RMA's estimates, it appears that enclosures around the cementing operations are capable of a

95% capture efficiency (i.e., of 100% of the solvent emitted as a result of cementing, 80% of the total is emitted at the cementing operations, of which 75% of the total is captured, and 20% of the total is emitted after cementing, leaving only 5% unaccounted for which is assumed to be lost at the cementing operations). The observed closures and vapor collection systems appear to be achievable of a high degree of capture for the available VOC and associated HAP fraction.[4] Thus, the current overall VOHAP removal efficiency is approximately 90%, derived by multiplying the 95% capture efficiency by the 95% emissions reduction efficiency of an incinerator.

In addition, one rubber tire manufacturing facility has been identified that has reformulated its cement to eliminate HAP, thus achieving a 100% emission reduction efficiency from cementing operations.

Based on information currently available to the EPA, the MACT floor for existing major sources of VOHAP would be the average of the top five best controlled sources. The top five best controlled sources identified to date include four facilities that incinerate the emissions from their cementing process (90 percent overall emission reduction efficiency), and one facility that has reformulated their cement to eliminate the use of HAP (100 percent emission reduction efficiency). The average emission reduction efficiency of these top five facilities is 92 percent. Thus, the MACT floor for existing major sources of VOHAP would appear to be the equivalent of a VOHAP emissions reduction efficiency of 92 percent. The MACT floor for new major sources of VOHAP would appear to be the equivalent of reformulation of cement to eliminate the use of HAP, and would achieve a 100 percent elimination of VOHAP emissions.

However, the RMA has indicated that cement reformulation may not be an acceptable method of HAP control in the rubber tire manufacturing industry, due to product and proprietary concerns (see section 7.4, Cement Reformulation or Elimination, of this document). Based on these concerns identified by the RMA, the EPA intends to investigate further the potential of cement reformulation or elimination as a method of HAP emissions control before making a final MACT floor determination for existing and new sources of VOHAP. However, the EPA does not intend to eliminate the possibility of cement reformulation or elimination from consideration.

6.0 IMPLEMENTATION

6.1 Small Business Considerations

No tire manufacturers that meet the applicable definition of small businesses are known to exist. If they did, they would not likely be major with respect to HAP emissions. Therefore small business considerations do not apply.

6.2 Cross-Media Impacts

Cross-media impacts from incinerators include the possible formation of nitrogen oxides and other pollutants. Cross media impacts of wet scrubbers include the production of wastewater. Of the available control strategies, only solvent elimination is entirely without cross-media impact.

6.3 General P-MACT Implementation Provisions

The general P-MACT implementation provisions are to follow 40 CFR Part 63, Subpart A (General Provisions for the Clean Air Act, section 112). A brief, general summary of these provisions are provided in Table 10.

TABLE 10. GENERAL NOTIFICATION AND OPERATION MONITORING

Activity	General Requirements
Recordkeeping	Records may be maintained electronically, in hard copy, or by another method approved by the permitting agency.
	Maintain records on-site for two years, and readily retrievable (i.e., accessible within 24 hours) for a period of five years.
	Submit verification that the technology is installed and is operating properly (e.g., monitoring data, calibration checks, start-up, shutdown, and malfunction records).
Reporting	Initial notification that a facility is affected by this rule to the Title V permitting agency.
	Permit application submittal or modification.
	Construction/reconstruction reports.
	Initial notification of compliance status.
	Source test reports.
	Notification of violations/exceedances.
	Start-up, shutdown, and malfunction reports.
	Notification of compliance status, including report of HAP emissions.
Monitoring of operations	Submittal of monitoring plan. Continuously monitor performance of emission status during operation - facility establishes monitoring plan in accordance with general guidelines.
Compliance period	Continuous unless exempted periods of performance

7.0 ISSUES AND UNCERTAINTIES

Determination of P-MACT is based on information currently available to the EPA. The process of developing P-MACT inherently identifies areas where additional information or review is needed. As a result, the conclusions drawn in the P-MACT document may change as more information is gathered or existing information is updated. The purpose of this chapter is to identify these areas of uncertainty. State and local agencies pursuing individual permitting actions or regulatory agendas should be aware of the following questions and concerns that the EPA may resolve during the course of the NESHAP MACT development. Users are requested to contact the Agency to discuss additional information.

The EPA, with input from the RMA, has identified several issues and uncertainties associated with HAP emissions and control from tire manufacturing. The following sections describe these issues and uncertainties. The EPA is requesting reviewers of this document to provide information on the issues and uncertainties identified in this chapter. Further, the EPA is requesting any additional/available technical documentation and information on controls identified for the various processes associated with tire manufacturing in general and passenger and light duty truck tire manufacture specifically, and their applicability to other types of tire manufacture (e.g., farm equipment, earthmover, motorcycle, aircraft, etc.).

7.1 Basis of Data Used for the P-MACT

The data used as the basis for this P-MACT were primarily obtained from active RMA passenger and light duty truck tire manufacturing facilities. Although this information may be applicable to the emissions of HAP from the rubber compound used in all types of tire manufacture, information has not been made available to the EPA that would indicate otherwise. Further investigation (e.g., demonstration and or documentation of quantitative compounding differences compromising the applicability of the proposed AP-42 EF for Rubber Manufacturing) into emissions from other types of tire manufacture is necessary before rejection and adoption of a series of EF can be positively concluded.

In addition, it is likely that the information presented in this document will not accurately address type and quantity of HAP emissions from cementing associated with the manufacture of other types of tires. Further information is necessary to completely address these HAP emissions from cementing.

7.2 Source Subcategorization

Source subcategorization may be considered by the EPA when types of emissions and/or operations make use of the same air pollution control technology infeasible. If a given control alternative is not appropriate for all sources in a source category, it is an indication that subcategorization may be needed. The EPA has not made a final decision on the subcategorization of the rubber tire manufacturing source category. However, certain operations have been identified that may be considered for subcategorization.

The rubber tire MACT standard must consider the potential for industry outsourcing or “hub” supply facility operations. Specifically, the MACT applicability and affected source definition would apply to “major” facilities or processes that may have been traditionally located on the same contiguous site but are now or may be separate sites, or whose products are used primarily in the production of rubber tires. Examples of such facilities include the mixing and compounding of rubber at a separate location and shipment of the compound to a non-contiguous location for use, tire cord manufacture, and inner tube manufacture. The EPA will address these facilities, and potentially other off site related component processing, however the evaluation may be limited to a finding of whether such facilities should be covered under the tire manufacturing standard or another standard.

In addition, the EPA has identified tire remold (retread) facilities as a candidate for source subcategorization. Preliminary information indicates that these facilities are operated in very much the same manner as a tire manufacturing facility, and have the potential to be major sources of HAP emissions.

The following subsections describe these operations and the issues that may make them candidates for subcategorization.

7.2.1 Tire Cord Manufacturing

The EPA has concluded that the manufacture of tire cord is an integral part of tire manufacturing, and may be significant sources of HAP emissions. Thus, a preliminary decision had been made within the EPA to include tire cord manufacturing in the tire manufacturing source category. Sufficient information to characterize HAP emissions from tire cord manufacture is not currently available.

Tire manufacturing facilities either have their own tire cord manufacturing facilities or another company makes the tire cord and sells it to them. It is estimated that approximately 90% of tire cord manufacturing is owned by tire companies.[11] Further, it is believed that tire cord manufacturing facilities make only tire cord, rather than making tire cord in addition to other products.

The RMA has indicated that in some tire manufacturing facilities, the tire cord is coated in-house at the tire manufacturer prior to calendering.[12] The only emissions from calendering at a tire manufacturing facility is from the rubber compound. However, if the cord is also coated in a tire manufacturing facility, there would likely be emissions from the tire cord web coating process associated with the generic resorcinol-formaldehyde liquid.

To accurately characterize emissions from tire cord manufacturing, the RMA is preparing a questionnaire for tire cord manufacturing facilities. Upon completion of the questionnaire, they will send it to tire cord manufacturing facilities, and provide the results to the EPA.

7.2.2 Off-Site Rubber Compound Mixing

Off-site rubber compound mixing refers to facilities that mix rubber compound for tire manufacturing that are not located at the tire manufacturer. Some off-site facilities exist that are major sources and only mix rubber compound for tire manufacturing for a limited time (e.g., approximately 10% of the time) on a regular basis. Other off-site facilities exist that produce engineered rubber products not associated with tire manufacture. However, if a tire manufacturing facility experiences a problem with their mixing operations they may request the engineered rubber products facility to mix a batch or so of rubber compound for use in tire manufacturing. This occurs occasionally, not on a regular basis.

Facilities that mix rubber compound for the sole purpose of providing rubber compound for tire manufacture would be included in the tire manufacturing standard. Facilities that only mix rubber compound for tire manufacture some of the time must be evaluated to determine if and how they will be included. For example, a facility that rubber-coats metal parts may be subject to another standard, and the compound mixing process may or may not be specifically cited as a controlled point. Thus, if the facility occasionally mixes rubber compound for a tire production facility, the rubber compound mixing operation may not be regulated for HAP emissions. Therefore the operations that mix rubber for the purpose of tire manufacture, regardless of the size of the mixing operation, must be evaluated during the tire manufacturing standard development process.

7.2.3 Tire Retread Facilities

There are two types of tire remold or retread facilities: those that make only stock, and those that put the stock around the re-ground tire carcass. The facilities that put stock around a re-ground tire carcass are smaller facilities and the RMA believes that they are not likely major sources.

During the EPA's initial data gathering effort, a tire retread facility was identified that was a major source. The Toxic Release Inventory (TRI) reported 414 tons of HAP released to the air by the tire manufacturer industry in 1994. Of the total HAP released, 43 percent was methyl chloroform (178 tons), and 29 percent was toluene. Bandag, Incorporated's Chino, California plant, a manufacturer of recapping material, accounted for 30 percent of the HAP emitted by this source category (125 tons). More recent information indicates that Bandag's Chino plant reformulated their cement and replaced the use of methyl chloroform with a non HAP solvent (heptane), effective August 31, 1995, thus eliminating methyl chloroform emissions from cementing (in addition, the plant employs a regenerative thermal oxidizer to control heptane emissions). Further, representatives of the facility state that although their pre-cured tread plants are sources of HAP emissions, they are not major sources.[13] However, the EPA believes that there is a question whether tire retread facilities exist that are major sources and intends to include them in the source category for further investigation.

7.2.4 Inner Tube Manufacturing

The RMA does not believe inner tubes are part of a tire, but rather are finished products unto themselves. One instance has been identified where a tire manufacturing facility also makes inner tubes. Although inner tube manufacturing was not included in the NSPS, the EPA is still evaluating whether the primary product and definition of tire manufacturing and components merits revision in order to address inner tube production within the tire manufacturing source category.

7.3 Particulate Emissions

Based on the currently available data it is not possible to conclusively state that particulate matter serves as a reliable indicator (surrogate) for HAP emissions, nor is it possible to accurately quantify particulate emissions from specific processes within a rubber tire manufacturing facility. However, based on the fact that (1) particulate emissions are currently controlled from mixing, milling, grinding, and in one case, curing operations; (2) the RMA has developed EF for particulate emissions as well as metals; and (3) the RMA expects metals to be detected in the particulate matter from mixing operations, the EPA believes that it is necessary and prudent to further investigate particulate emissions from tire manufacturing.

7.3.1 Particulate Emissions from Tire Curing Operations

The EPA has identified one rubber tire manufacturing facility in the State of Virginia that currently controls particulate emissions from some of its curing lines with ESP. The RMA and the EPA believe that there may be volatile and semi-volatile emissions from the tire curing operations, and is unsure whether some of these emissions could be defined as PM.

The RMA conducted an EF study for the rubber industry that included emissions from a tire curing press. The constituents emitted to the air from curing were generated through volatilization of materials in the products being cured. The RMA believes that if PM is present, it is only in the form of semivolatile residues that may condense and form aerosols. During the testing some of the semi-volatiles were collected and detected in Method 25A tests, and reported as emissions from curing. Based on the HAP speciation associated with this EF study, the semi-volatiles emitted from curing were only approximately 5% of the total HAP emitted from the curing operation. The RMA indicated that the PM being released from the tire curing operations are not necessarily indicative of HAP, and that even if they are, the emissions are not present in sufficient concentrations to warrant regulation.

The EPA is interested in further characterizing these emissions before assuming that the PM is not indicative of HAP. The EPA requests that readers of the P-MACT comment on the potential for PM to be indicative of HAP, the appropriateness of the use of ESP to control PM from tire curing operations, and speciation of semi-volatile compounds emitted from curing operations.

7.3.2 Particulate Emissions From Grinding Operations

The RMA has indicated that they believe grinding operations at tire manufacturing facilities are insignificant sources. The amount of rubber ground and the amount of HAP emitted is very small. The EPA believes that enough information exists (e.g., cyclones and scrubbers have been identified as control devices on grinding operations, EF exist in AP-42 for PM from grinding operations) to characterize emissions and control of emissions from grinding operations. Therefore, at a minimum, the EPA intends to evaluate emissions from grinding operations to determine if they warrant exclusion from further consideration, based on the possibility that they are "de-minimus" sources, or if they should be considered as sources of emissions within the tire manufacturing source category.

7.4 Cement Reformulation or Elimination

Cement reformulation or elimination has been suggested by the EPA as a possible method for reduction or elimination of HAP emissions from cementing operations. The RMA has stated that each rubber tire manufacturer has developed a manufacturing process that yields tires with specific properties to meet performance standards, safety requirements, and original equipment contract specifications, where applicable. Due to product properties provided through the use of solvents and cements, cement reformulation or elimination can only be achieved through extensive product redesign and testing. Premature replacement or elimination of solvents without adequate research and testing may compromise quality and safety of the product.

In addition, the RMA states that tire manufacturing processes are, in large part, proprietary in nature. In particular, different companies use different formulas in the manufacture of tires. Types and quantities of materials, including solvents, vary and are closely-guarded trade secrets. Given the proprietary nature of solvent formulations, the RMA believes it is not possible to disclose tire manufacturing formulas, and thus not appropriate to consider the elimination or reformulation of cement as a means of HAP emissions reduction or elimination.

The EPA recognizes the concerns stated by the RMA regarding product properties and proprietary information. However, the EPA is not prepared to eliminate the consideration of solvent elimination or reformulation as an emissions control method at this time. The EPA intends to investigate further the potential of cement reformulation or elimination as an emissions reduction method, before reaching any conclusions, and will work closely with the RMA on this action.

7.5 HAP Content of Cement Solvent and Cement Use

Information currently available to the EPA indicates that the HAP component of cement solvent may be as low as 0% or as high as 90%. The EPA used a value of 90% to represent the HAP component of cement solvent in this P-MACT document. The EPA recognizes that this value represents "worst-case" and that the industry average is likely lower. The EPA intends to further investigate the composition of cement solvent in an attempt to more accurately characterize the industry.

No adequate database for the apportioning of cement solvent VOHAP emissions by process unit currently exists.[9] To account for the potential cement solvent emissions in this P-MACT analysis, the EPA assumed that 80% of the cement solvent is emitted during the cementing process, 12% of the cement solvent is emitted during the tire building process, and 8% of the cement solvent is emitted during the curing process.[2,10] The values are generally accepted as typical for the industry, but may vary substantially between facilities. However solvent and cement usage records for the individual tire manufacturing operations are maintained and associated testing of coatings would be used in MACT for quantification. The EPA intends to further investigate, with the help of the RMA, the use of cement among the process units within the tire manufacturing industry.

7.6 Alternative Emission Standard

This P-MACT document structures the MACT floor determinations to specify emissions control technologies and emissions reduction efficiencies for individual process units and steps within the tire manufacturing industry. The RMA has requested the EPA consider allowing tire manufacturing facilities to establish an alternative emissions standard across different units or to achieve a facility-wide emissions standard. The RMA has developed emissions factors, expressed as mass of emissions per pound of rubber compound processed. These EF, currently under review by the EPA, would allow overall facility emissions to be calculated with relative ease, and would apply evenly throughout the industry.

The EPA believes that an alternative emission standard may be an appropriate method by which tire manufacturing facilities could demonstrate compliance with the rubber tire manufacturing NESHAP. The EPA will consider the alternative during the NESHAP development. If it is determined that an alternative emission standard is an acceptable means of complying with the NESHAP, the EPA will work with the RMA and the regulatory community to develop workable alternative emission standard application criteria.

8.0 REFERENCES

1. Standards of Performance for the Rubber Tire Manufacturing Industry, 40 CFR Part 60 Subpart BBB.

2. Letter from Tracey J. Norberg, Director, Environmental Affairs, Rubber Manufacturers Association, Washington, D.C. to Anthony P. Wayne, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, RE: Draft Presumptive MACT for Rubber Tire Manufacturing. March 17, 1998.

3. Internet site for Tire Business, http://www.tirebusiness.com. April 1998.

4. General information gained from available State files, existing literature, site visits to several rubber tire manufacturing facilities during 1996 and 1997, HAP emission inventories from rubber tire manufacturing facilities, and informal conversations with personnel associated with the rubber tire manufacturing industry.

5. Letter from H. Dean Downs, Jr., Environmental Engineer Senior, Department of Environmental Quality, Commonwealth of Virginia to Tony Wayne, USEPA, Research Triangle Park, North Carolina, RE: BACT Re-evaluation for Yokohama Tire Corp. December 17, 1997.

6. Emission Factors for Hazardous Air Pollutants from Rubber Tire Manufacturing. The Rubber Manufacturers Association. Washington, D.C. 1995.

7. Confidential Business Information submitted by Facility A to Calvin Overcash, EC/R Incorporated. April 28, 1998.

8. Confidential Business Information submitted by Facility B to Calvin Overcash, EC/R Incorporated. May 6, 1998.

9. Telephone conversation between Ron Clark, Environmental Mitigation Group, and Wally Sanford, INDUS Corporation. March 12, 1997.

10. Rubber Tire Manufacturing Industry - Background Information Document for Proposed Standards, EPA-450/3-81-008a. July 1981.

11. RMA presentation "RMA Application of Emission Factors - EPA Training", presented to USEPA, November 12, 1996.

12. Meeting between the RMA and the EPA in Durham, North Carolina to discuss the draft Presumptive MACT. April 2, 1996.

13. Letter from Paul E. Crosser, Manager, Corporate Environmental Services, Bandag, Incorporated, Muscatine, Iowa to Anthony P. Wayne, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, RE: MACT Preparation for the Rubber Tire Industry; Emissions from Pre-Cured Tread Production for Tire Retreading. April 21, 1998.